



**THE HONGKONG UNIVERSITY OF SCIENCE & TECHNOLOGY**

**Department of Mathematics**

**SEMINAR ON APPLIED MATHEMATICS**

**Clean Numerical Simulation (CNS) of  
two-dimensional Kolmogorov flow**

**By**

**Prof. Shijun LIAO**

Distinguished Professor  
Shanghai Jiaotong University

**Abstract**

Direct numerical simulation (DNS) has been widely used to simulate turbulent flows, whose results are often widely used as reliable benchmark to better understand turbulent flows. In this talk, using 2D Kolmogorov flow with an initial condition having a spatial symmetry (whose exact solution governed by the NS equation must have the same spatial symmetry) as an example, we compare DNS results with those given by the Clean Numerical Simulation (CNS) whose numerical noises are negligible in a long enough interval of time (this is quite different from DNS). It is found that DNS result loses its spatial symmetry quickly and thereafter is obviously polluted badly by numerical noises. However, the CNS result always keep the spatial symmetry. It is found that the DNS result deviates from the true solution not only in tempo-spatial trajectory but also even in long-term statistics and spatial symmetry. Some general beliefs on the NS equations are discussed. A few open questions are given.

**CV of Dr. SHIJUN LIAO**

Prof. Shijun Liao is a distinguished professor, School of Naval Architecture Ocean and Civil Engineering, Shanghai Jiaotong University, China. He is currently the head, State Key Laboratory of Ocean Engineering, China.

Prof. Liao is the founder of the “homotopy analysis method” (HAM), an analytic approximation method for highly nonlinear problems. Today, the homotopy analysis method has been widely used by researchers all over the world. Besides, he proposed a new strategy to gain reliable numerical simulations of chaotic systems, called the “Clean Numerical Simulation” (CNS). The CNS provides a totally new tool to investigate chaos and turbulent flows and to attack some open questions.

Prof. Liao has published two monographs and about two hundred articles. His books and publications have been cited 20163 times in scholar-google. He was awarded “Shanghai Award in Natural Science” and “National Award in Natural Science”. He was listed among “the Highly Cited Researcher” in 2014, 2015 and 2016.

**Date : 24 May 2024 (Friday)**

**Time : 3:00p.m.-4:00p.m.**

**Venue : Room 5583 (near Lift 27/28)**

*All are Welcome!*